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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,388	12/10/2003	Ramachandra Divakaruni	FIS920030274	1387

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ALBANY, NY 12207

EXAMINER

FULK, STEVEN J

ART UNIT	PAPER NUMBER
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2891

DATE MAILED: 12/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/707,388

Applicant(s)

DIVAKARUNI ET AL.

Examiner

Steven J. Fulk

Art Unit

2891

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 22 September 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-11 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 12-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application
- ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment filed September 22, 2006, which amends claims 12 and 20, has been entered. Claims 12-20 are currently pending.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 12, 19 and 20 are rejected under 35 U.S.C. 102(e) as being anticipated by Buskirk '175.

By both the conventional definition in the art and by the Applicant's definition provided in the specification, a back-end-of-line (BEOL) layer can comprise an ILD layer (Applicant's specification, ¶16, "ILD layer may be any BEOL layer...containing a via and/or metal.") or a metal layer (Applicant's specification, ¶18, "conventional BEOL wiring structure could be...a via to underlying wiring layers or a simple wire."), so long as the layer is formed over the front-end-of-line (FEOL) structures found on a silicon substrate.

Regarding claims 12 and 20, Buskirk discloses a semiconductor device comprising a silicide resistor (fig. 1E, 30A; ¶13, damascene resistor made of

silicide) positioned in a trough in one of a plurality of back-end-of-line (BEOL) layers (20 is formed over substrate 10, which is disclosed to have front-end-of line (FEOL) structures such as transistors, ¶15). It is inherent that the silicide resistor had a silicidation temperature less than a damaging temperature of the plurality of BEOL layers in light of the fact that the structure is built and operates as intended, thereby meaning the BEOL layer (20) was sufficiently undamaged during the silicide formation process.

Regarding claim 19, the reference further discloses the device to comprise a polysilicon base (fig. 1E, 16; ¶15, polysilicon plug) positioned below the silicide section.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 13-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk '175 in view of Wolf, Vol. II (NPL Reference "U", previously provided).

Buskirk discloses all of the elements of the claims as discussed above, including a resistor comprising a silicide section positioned in a trough one of a plurality of BEOL layers, but the reference does not explicitly teach the use of specific metals, such as cobalt, palladium, platinum, molybdenum, tungsten and nickel, as the silicide material.

Wolf teaches the use of the silicides of cobalt, palladium, platinum, molybdenum, tungsten and nickel in BEOL resistors (Wolf defines "multilevel interconnects" to include ILD layers, vias, and metal lines (p. 176), thereby meaning BEOL layers as defined above; and because interconnects inherently have a resistance, they are classified as "resistors"). Wolf also teaches the inherent resistivity associated with each silicide (p. 193, Table 4.3; p. 146): cobalt silicide has a resistivity between 14-20  $\mu$ -ohm/cm (p. 193, Table 4.3); palladium silicide has a resistivity between 25-30  $\mu$ -ohm/cm (p. 146); platinum silicide has a resistivity between 26-35  $\mu$ -ohm/cm (p. 193, Table 4.3); and nickel silicide has a resistivity of 50 ohm/cm (p. 146). Wolf teaches the silicidation temperature of these metals as 600 °C or less (p. 146), which reads on a silicidation temperature less than a damaging temperature of the plurality of BEOL layers in light of the fact that the Applicant's specification gives illustrative examples (species) of silicidation temperatures less than a damaging temperature of the plurality of BEOL layers (genus) that are of 600 °C or less, therefore the temperature species of 450 °C reads on the broad genus of "silicidation temperatures less than a damaging temperature of the plurality of BEOL layers".

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the silicide metals of Wolf in the resistor of Buskirk. One would have been motivated to do this because Buskirk taught that the resistor could be made of any silicide capable of transmitting an electric signal (§13), and Wolf taught that the resistivities of these metals were such that they can transmit electric signals (p. 193), thus allowing the device of Buskirk to perform its intended

function. The metals listed by Wolf were also a limited set of conventional metals used in semiconductor interconnects that were known to form stable silicides.

### ***Conclusion***

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Lai et al. '621, Bradshaw et al. '873 and Carroll et al. '496 disclose a resistor comprising a silicide section positioned in a trough of a BEOL layer.

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven J. Fulk whose telephone number is (571)

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272-8323. The examiner can normally be reached on Monday through Friday,  
9:30am to 6:00pm.

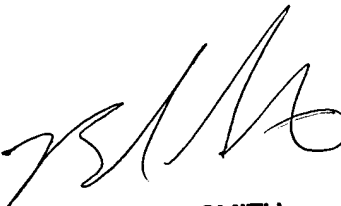
If attempts to reach the examiner by telephone are unsuccessful, the  
examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax  
phone number for the organization where this application or proceeding is assigned  
is 571-273-8300.

9. Information regarding the status of an application may be obtained from the  
Patent Application Information Retrieval (PAIR) system. Status information for  
published applications may be obtained from either Private PAIR or Public PAIR.  
Status information for unpublished applications is available through Private PAIR  
only. For more information about the PAIR system, see [http://pair-  
direct.uspto.gov](http://pair-direct.uspto.gov). Should you have questions on access to the Private PAIR system,  
contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you  
would like assistance from a USPTO Customer Service Representative or access to  
the automated information system, call 800-786-9199 (IN USA OR CANADA) or  
571-272-1000.

SJF

Steven J. Fulk  
Patent Examiner  
Art Unit 2891

December 4, 2006

  
BRADLEY K. SMITH  
PRIMARY EXAMINER